COTTON CULTURE

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A GUIDE FOR RAISING
PROFITABLE COTTON CROPS

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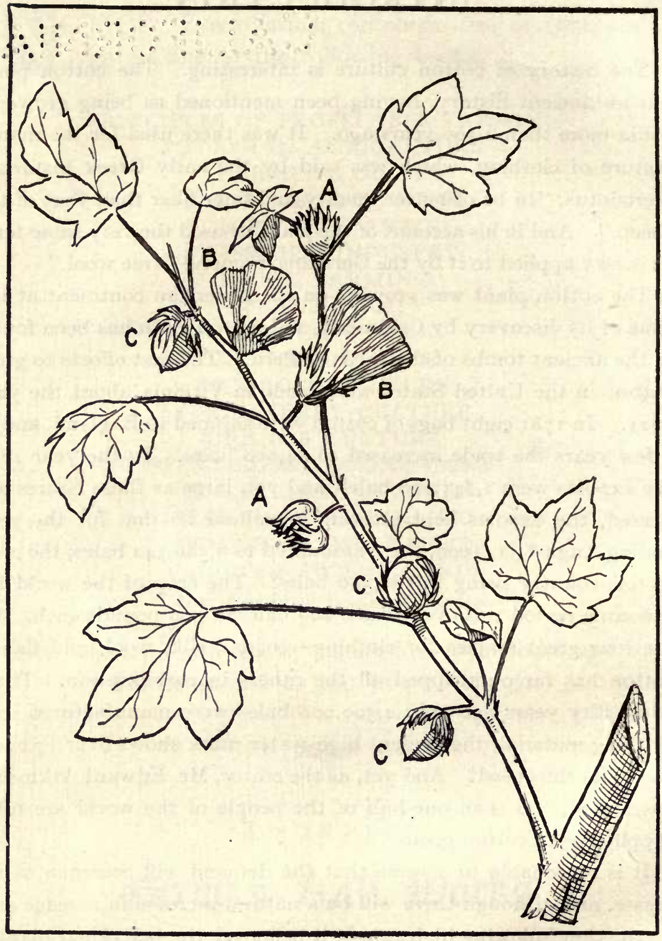
INTRODUCTION

The history of cotton culture is interesting. The cotton plant has an ancient history, having been mentioned as being grown in India more than 2,500 years ago. It was there used for the manufacture of clothing, which was said by the early Greek historian, Herodotus, "to be of better quality and finer fiber than that of the sheep." And in his account of the plant he used the very same term as is now applied to it by the Germans, namely, "tree wool."

The cotton plant was growing on the American continent at the time of its discovery by Columbus, and cotton cloth has been found in the ancient tombs of the Incas of Peru. The first efforts to grow cotton in the United States were made in Virginia about the year 1621. In 1781 eight bags of cotton were shipped to England, and in a few years the trade increased to 84,000 bales. In the year 1861 the exports were 1,841,000 bales, and yet, large as these figures appeared, the exports kept growing in volume so that for the year ending August 31, 1909, these amounted to 8,566,342 bales, the crop in this country being 13,587,306 bales. The crop of the world for the same period was over 18,000,000 bales of 500 pounds each. Of the four great staples for clothing—cotton, silk, wool, and flax—cotton has far outstripped all the others in consumption. Thus, while fifty years ago only 2,500,000 bales were manufactured into clothing material, the present high-water mark shows over 17,000,000 bales thus used! And yet, as the editor, Mr. Edward Atkinson, has stated, less than one-half of the people of the world are fully supplied with cotton goods.

It is reasonable to assume that the demand will continue to increase, and although there will be a natural increase in acreage and production following high prices, it behooves the individual planter to safeguard his own interests by increasing the yield on each acre by intensive methods of culture.



A, bud. *B*, blossom. *C*, boll or "square."

THE COTTON PLANT.

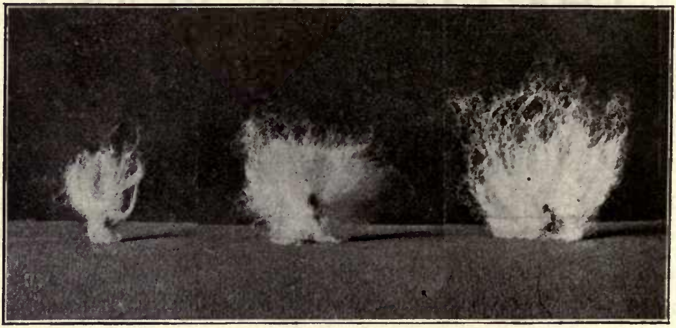
THE COTTON PLANT

SEED-COTTON is the fruit of a plant belonging to the same botanical order as the mallow, hollyhock, and okra. It belongs to the genus Gossypium, and the number of species or types is variously stated to be from four to forty-two. Agriculturally and commercially, cotton is usually classified by "grade," according to quality, length of fiber, etc., and the locality in which it is produced.

Two great classes are recognized: Oriental and Occidental, or Eastern and Western. The chief distinguishing feature between these two classes lies in the color of the seed, the Eastern cotton having black seed, while the Western varieties are green seeded. There are two distinct types of North American cottons, (1) the famous "Sea-Island" (black-seeded) or "long staple," and (2) the "New Orleans" (green-seeded) or "short staple."

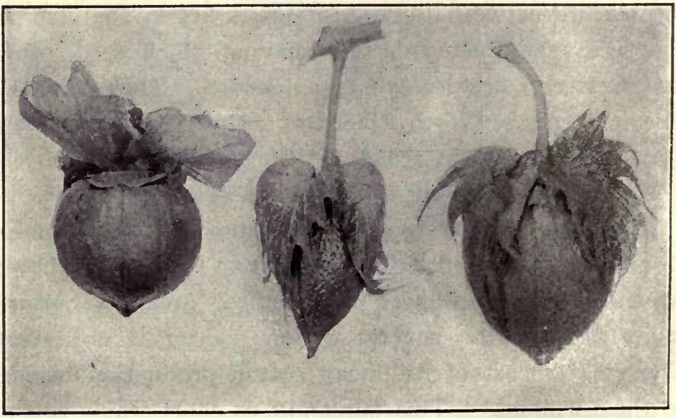
Sea-Island cotton seems to require the even moist climate of low-lying districts, where frost is scarcely known. As this fiber is produced in a limited area, its cultural importance to the general cotton planter is not great. The greater part of American cotton production belongs to the "Upland." This "upland," or short staple cotton, covering a vast proportion of the cotton area, is the cotton of the planter, and the kind referred to in this book where no other grade is specified.

With proper culture the cotton plant will grow from four to six feet high, while under conditions particularly



Wild. Upland. Sea Island.

TYPES OF COTTON FIBERS.

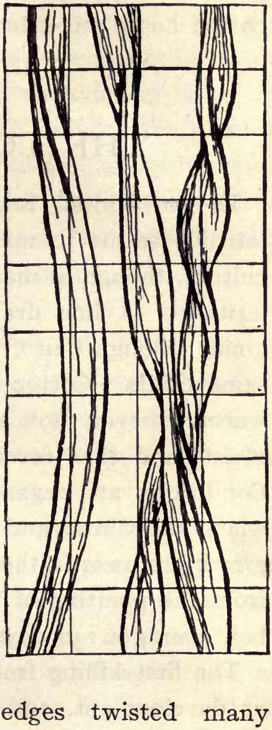


India. Sea Island. American Upland

TYPES OF COTTON BOLLS.

favorable it will reach a height of eight feet or more. The blossoms are white on the first day, become pink on the

second, and fall on the third, leaving the embryo "boll" enveloped in the calyx. This boll or "square" is really a seed pod in which the seeds develop surrounded by the protecting filaments of fiber, which constitute the cotton of commerce. On ripening, the boll separates into three to five or more cells, much as a chestnut burr opens, the cotton fiber being at first so compact as to preserve the shape of the compartment it had filled, but, soon drying, protrudes from the pod in a fluffy mass.



The cotton plant possesses a well-developed tap root, extending, according to the vigor of the plant and the character of the soil, to a depth of three or more feet. The lateral, or feeding roots, begin usually within three inches of the surface, and seldom extend below a depth of nine inches.

Cotton fiber, when examined under a microscope, resembles a collapsed tube with corded edges twisted many times throughout its length, and has the appearance of an elongated cork-screw or carpenter's auger. These convolutions or twists are less frequent as the fiber is less matured, and are almost altogether absent in the imma-

ture fiber. In making thread, these "twists" interlace with one another, which action assists in the formation of a strong thread from comparatively so weak a fiber as cotton. The average length of an ordinary cotton fiber in the United States is one and one-tenth inches. Sea-Island cotton has a much longer fiber.

THE COTTON CLIMATE

In the United States, the thirty-seventh parallel of latitude seems to mark the limits of economical cotton culture, though in many places the line curves below that latitude. A line drawn from Old Point Comfort, Virginia, through Cairo, Illinois, would cover practically the same limits. Cotton is a plant which thrives in a very warm or even hot atmosphere, providing the latter is moist, and that severe drying winds are not prevalent. Conditions are regarded unfavorable to cotton culture where the winter and spring temperatures are low, as the growing season is then liable to be too short. The time from the planting of the seed to the bursting of the first boll averages 130 days.

The first killing frost of autumn checks further growth or development, and, according to its severity, destroys the plant and all immature bolls. For economical culture, the crop requires six or seven months of favorable growing weather. In the typical cotton climate, the mean daily temperature increases from the time of seeding,

until about the first of August, after which time it falls considerably, thus making two distinct periods in the life of the plant.

During the first period of high and increasing temperature the plant should be in full growth, and by the first, or middle of August, it should have stored up all the food it needs. From this time on, a decreasing temperature is favorable to the production of a maximum crop; for this checks the further growth and induces the plant to convert into fruit the food material it has accumulated.

Cotton thus requires an early start and a long season. It is a semi-tropical plant, and must have semi-tropical weather, long enough to mature its fruit.

COTTON SOILS

Cotton can be grown successfully on a great variety of soils. In fact, cotton flourishes almost anywhere in the Gulf States, whether the soil be sand, clay, sandy loam, limestone, peaty or black prairie land.

On sandy uplands, the yield is generally small; on clay soils, and with a wet season, the plant may attain a large size, but gives little lint in proportion to leaf and stalk. Rich bottom lands are apt to produce results similar to those of clay soils in a wet season, and are not ideal soils for cotton, but rather for corn and the grasses; but with a favorable season they yield heavily. The best type of soil for producing favorable results is a light clay loam or medium heavy sandy loam with a subsoil that is not too heavy and compact.

In the so-called "cotton belt" the presence of iron causes many sands and clays to be colored a more or less marked red, and farmers are accustomed to call them "red" to distinguish them from "gray" soils. All things considered, the red clay soil may be considered the more favorable of the two, when sufficiently porous to be easily freed of surface water—a condition usually indicated by the presence of small quantities of fine red gravel. The native forest growth of such soils is generally long-leafed pine, with hickory, oak, and maple in the bottoms.

The amount and distribution of rainfall has much to do with successful cotton culture, and this fact should be kept in mind when selecting soils. On heavy clay and rich bottom lands, the crop receiving too free a rainfall frequently becomes diseased or injured by insect ravages, or is delayed in maturing by rank vegetative growth until the appearance of frost. A good cotton soil should maintain uniform conditions of moisture, as sudden variations in the growing season affect the vitality of the plant. Up to August, the soil should be continuously moist, but not wet. A sandy soil is apt to be too dry, and a heavy clay soil too wet. Excess of decaying organic matter, or peat, indicates an excess of nitrogen, as well as moisture, which tend to luxuriant growth of "weed" at the expense of fruit and early maturity.

The young and tender cotton roots penetrate to a considerable depth. If the soil is washed from around a well-grown cotton stalk, a large number of fibrous roots will be found on the laterals. The roots penetrate three and

even four feet deep in a loamy soil, thus showing clearly that the plant thrives best in a porous soil which is naturally or artificially drained to a good depth. This is proved by well grown plants making such root development and also by the fact that such a root system enables the plant to draw upon a larger water supply in case of drouth, and to reach a larger source of fertilizer supply than would be the case with a narrow or contracted root development.

Physical difficulties in a soil may be at least partially corrected as follows: (1) If the soil be heavy and wet and thus cold in the spring, and inclined to bake during a drouth, the remedy is ditching, or, better still, tile drainage. This should be followed by deep plowing and subsoiling in the fall, in order that the "freeze" may have a beneficial effect. (2) The soil may be improved, if too loose, by a leguminous crop such as cow-peas or clover, whereby a large amount of organic matter is incorporated, which checks the quick dissipation of water in soils which are too porous. Lime, also, has a very powerful action in opening compact soils, and in binding together those which are too loose.

PREPARATION OF THE SOIL

Many large tracts of land, which the cotton planter is called upon to cultivate, have never borne any crop but their natural forest covering. It is always expensive to clear the land. When the native growth of wood has a commercial value, it is cut and sold for timber. The

cheapest plan of getting rid of the forest growth is about as follows: The trees are girdled in autumn or winter, followed by "firing" to kill undergrowth and remove fallen timber. In many cases the plow can be put at work without cutting out the larger timber, but then the first plowing will be more or less imperfect, and the after cultivation attended with considerable difficulty. In about three years, however, the soil may be worked with a fair amount of profit.

The great, if not sole obstacle, to the introduction of improved agricultural machinery in cotton culture in the South, is the presence of roots and stumps of trees. These should be removed either by digging out or, in the case of pine stumps, by burning. Dynamite is sometimes used. Digging is too expensive for large tracts, but may be practiced on small areas, when men and teams would not be otherwise employed. The small Southern oaks, which do not root deeply, are the trees most susceptible to removal by this method. There are several kinds of stump pullers which may be used effectively and the manufacturers will gladly furnish full information as to their use.

Removing stumps by the use of dynamite costs about five cents per stump, and is a very simple operation. A small cavity is made under the roots, the cartridge dropped in, and the fuse ignited. There is no danger in the use of dynamite if properly handled, but it is always advisable first to get instructions from an experienced person.

If cotton is to follow cotton, the old stalks should be

broken down as early as possible, so that they may have time to decay in the soil. As the object is to get the soil into such a condition that thorough plowing may be practicable, many rough-and-ready devices are used, but a well-designed machine "stalk-chopper" is the most economical.

The old-fashioned way of plowing, still too much in vogue, is by the use of a one-horse plow, shod with a turn shovel. This crude implement has largely given way to factory-made two-horse plows and these are being substituted, to an increasing extent, by the modern disk-plow requiring two or three heavy mules, or horses. Such a plow will turn and disintegrate the soil to the depth of eight to twelve inches, or more, as may be desired. It is a very effective implement.

Subsoiling is not now practiced to the same extent as formerly and is of doubtful profit. If done it should be confined to stiff clays and the work should be performed in the fall or very early winter.

With heavy clay soils, and on land not subject to severe washing, plow early in winter; with lighter soils, or soils so situated as to be subject to washing, plow only shortly before planting. To turn over a light soil in winter means a considerable loss of fertilizer by the drainage of winter rains. The general depth of plowing is about four inches; it should not be less than six, and on heavy clay soils eight inches is better. To increase the depth of a soil, the plow should be set deeper very gradually. A gain of one-half inch per annum is probably all that may be safely attempted.

Bedding the Land. The foregoing suggestions in regard to "preparation of the soil" refer only to the broadcast, preliminary breaking which will be necessary in stiff soils or those covered with more or less trash, weeds, grass, and the débris of the preceding crop.

If the soil does not crumble readily, and the surface is rough and uneven, it should be harrowed once or twice before the time for putting in manures and fertilizers. From two to three weeks before planting time the land should be laid off in rows varying from three feet wide, on land capable of producing less than one bale of cotton, to three and a half to four feet and upwards, on land capable of producing from one to two bales per acre.

The fertilizer, or manure, should be put in these furrows, then the scooter-plow run in them to mix all together and finally a broad list made by throwing two furrows, back to back, on the center furrow. If these listing furrows be made with a two-horse plow a very narrow balk will be left to be split out just before, or immediately after, planting the crop.

THE WASHING OF SOILS

To check the damage from washing as much as possible, furrows and rows should run with the contour of the surface around the hills, or at right angles to the line of the greatest fall. The result is, that the furrow, or cotton, row, crossing the line of the fall, offers an obstruction to the flow of water down the hillside, and, by dimin-

ishing the flow of water, largely prevents damage by washing.

The only effective check against washing of soils, especially subject to it, is terracing. This consists in laying the slope off into slips parallel with the contour of the elevation; that is, at right angles to the slope. By this means, level steps independent of each other are made, and the slopes between them are seeded to grass and thus sod-protected. The foundation lines of the terrace may be accurately laid off only by means of a regular terracing level, preferably one with telescopic sights. Such an instrument will cost from ten to twelve dollars. The old-fashioned "rafter" level does fairly well for running grade rows or grade ditches, but is not at all reliable for locating a "dead-level" line, which is the essential of the terracing system. The makers of the improved levels usually supply a printed manual of instructions for the guidance of beginners.

Each step thus made is plowed by itself, a side-hill or a reversible disk-plow being used, and the furrows are run back and forth along the edge of the land instead of around it, and are turned down hill. The steps gradually become level. The practice of throwing up a considerable bank or dam along the line of the terrace is not to be commended, even though effective in preventing the water from escaping, with destructive force, to the step below. It is better to make the edge of the terrace perfectly level from end to end, and without any bank or dam to pond up the water along and above its course. The correct theory is to

plow the successive steps, or inter-terraces deeply, so that the soil will absorb any ordinary rainfall. In case of an excessive downpour, the surplus water that might otherwise form a pond will flow over the edge in a continuous thin sheet, with little destructive force.

On very slight slopes, side-hill ditching, following the contour of the slope, will serve to catch and remove the flood of surface water. These ditches are easily thrown up by the plow.

ROTATION OF CROPS

The chief object of a rotation of crops is to renovate the soil; that is, to give it a change in cultural methods. By such means various forms of insect ravages are checked, the mechanical quality of the soil is improved, and its natural fertility made more available. The rotation of crops is not always advisable, nor always economical, but as a general rule it is useful, inasmuch as it diversifies the products of the farm. By including clover, or other legumes, such as cow-peas, in the rotation, the fertilizer bill for nitrogen can be cut down one-half, as these leguminous plants take nitrogen from the atmosphere and convert it into suitable plant food.

In a climate suitable for cotton culture, two hoed crops should not follow each other. The soil under such circumstances becomes too much exposed to the sun and washing rains. Thus, fertility in the shape of organic matter is rapidly destroyed, or washed from the soil. If the soil is very rich in organic matter, hoed crops may

follow each other in succession, but it is an unnecessary waste of fertility, besides an injury to the physical condition of the soil.

The common practice in the South has been to grow cotton continuously, with small tracts in corn for feeding work-stock on the farm. Then the corn acreage is put into cotton the following year. Under usual conditions it would not be profitable to grow tracts of corn of such size that the whole plantation would alternately be in corn or cotton, or, each year half cotton and half corn. Corn is rarely profitable as a sale crop in the South, hence good planting would restrict the corn acreage to such tracts as will about supply the needs of the farm or plantation.

It is entirely practicable to so diversify farm practice as to provide for the home consumption of much larger food crops. This necessitates the breeding and fattening of beef cattle, the production of milk and butter, the breeding of horses and mules, swine for pork and bacon, sheep for mutton, and poultry and eggs for the table and for market. Such a course would call for a larger production of field crops for food purposes and at the same time afford a wider field for rotation, a larger product of animal manures, and the more rapid restoration and permanent improvement of the soil.

Under such a system small grain and hay would become a more valuable addition to food resources. The plan would permit of a comparatively equal division of the crop area on most farms between cotton, Indian corn, small grain, cow-peas, etc.

A good rotation would be as follows:

1st year: Cotton, highly fertilized.

2d year: Corn and cow-peas, moderately fertilized.

3d year: Oats and wheat, highly fertilized and followed immediately by cow-peas for hay, fertilized with potash and phosphoric acid.

If desired, or more convenient, cotton might be followed by oats, wheat, and other small grains (and cow-peas for hay) and these last by corn the next year. So the rotation would then read:

1st year: Cotton, highly fertilized.

2d year: Small grain sown in the previous fall, highly fertilized, followed by cow-peas for hay in the spring.

3d year: Corn and cow-peas.

In the heart of the cotton belt, oats should be the principal, if not the only, small grain, being sown in October in "open furrows" and liberally fertilized, to be followed immediately after harvest by cow-peas fertilized with acid phosphate and potash and the vines made into hay.

On the northern edge of the cotton belt, and still further north, wheat might be made the principal small grain crop. Likewise, tobacco may be substituted, in whole or in part, for the cotton in those sections where these two crops compete with each other as money crops.

By the above-outlined system the larger part of the farm would be pretty equally divided between three crops and their incidental or "catch" crops. Other portions could be devoted to various forage crops, fruit, truck, pasture, etc.

The effect of the plan would be to have one renovating

crop every third year—the small grain and cow-peas—and a partial crop of cow-peas one of the remaining years (with corn).

Moreover, the cotton fields that are to be planted to corn the following year, may be sown down in September or October to such legumes as crimson clover, bur clover, or vetch, and fertilized with potash and phosphoric acid, the crop to be turned under early in spring.

In sections where red clover succeeds well (limestone regions), it may take a two years' place in the rotation following cotton, intermitting corn, and itself followed by small grain.

By adopting and faithfully following one of the above systems, modified according to circumstances, it will be easy to bring up, in three or four years, the productive capacity of the soil from one-half bale of cotton, or twelve bushels of corn, or twenty bushels of oats, per acre, to double or even treble and quadruple these amounts.

A smaller area in cotton, which would be necessary under such a plan, may be made to produce a larger number of bales at a smaller cost per pound, and therefore yield a larger profit. A somewhat reduced area in corn and a much increased area in small grain and legume (cow-pea) hay, supplemented with suitable pasture, would sustain and fatten for market the improved animals bred for that purpose, and these would return to the soil a large quantity of rich manures for the improvement and enrichment thereof.

MANURING OR FERTILIZING

The proper selection and application of plant food, called manures and fertilizers, is really the most important feature in making cotton at a profit. The planter must always bear in mind that manures or fertilizers are useful in agriculture as plant food only to the extent that they contain potash, phosphoric acid, and nitrogen. Other substances are necessary, such as iron, silica, lime, etc., but most soils contain such in ample quantities, with perhaps the exception, occasionally, of lime. The mechanical improvement of soils is quite a distinct feature from the manuring or fertilizing of them. Both lime and organic matter improve the mechanical condition of soils, and potash salts (used in the form of fertilizers) increase the power of soils to withstand drouth.

It is important at the outset for the planter to understand fully just what work the three plant-food ingredients are expected to do; for their work is precisely the same, whether derived from farmyard manure or mineral fertilizers. All three ingredients, potash, phosphoric acid, and nitrogen, are absolutely necessary. If any one of them is missing, plants will not thrive and grow. In fact, each of these three fertilizing elements has its own separate and individual function, and one cannot be substituted for the other.

All manures are valuable, almost solely for the potash,

phosphoric acid, and nitrogen they contain, and a short account here of each may not be out of place.

Potash. Potash is essential to the formation and transference of starch in plants. Starch is first formed in the leaves of plants, after which it becomes soluble enough in the plant cells to pass through the cell walls gradually and later to be carried into the fruit, where it accumulates and changes back into insoluble forms, thus contributing to the formation of pulpy matter in the case of fruits and of lint in the case of cotton. Not only has this function of potash been well established, but it has also been proved that no other element or substance can take the place of potash in performing this work. Potash is also important on account of its influence upon the development of the woody parts of stems, roots, bark, and branches.

Phosphoric Acid. Phosphoric acid is found in the seeds of plants, and it has been discovered that plants cannot come to maturity unless this element is present in sufficient quantities. It hastens the maturity of plants and tends to aid the plant in assimilating other fertilizer ingredients. It also promotes the accumulation of albuminoids in the seeds.

Nitrogen. The influence of nitrogen in its various forms upon plant growth is shown by some very striking effects. The growth of stems and leaves is greatly promoted, while that of buds and flowers is retarded. Ordinarily, plants, after a certain period of growth, cease to produce new branches and foliage, increasing those already

Incomplete Fertilizer (Phosphate and Nitrogen). Yield, 1780 lbs. Seed Cotton.

EXPERIMENT BY W. S. MURPHY, WILDERSVILLE, TENN.

Completely Fertilized (Potash, Phosphate, and Nitrogen).
Yield, 2040 lbs. Seed Cotton per acre.

EXPERIMENT BY W. S. MURPHY, WILDERSVILLE, TENN.

formed very much more slowly, and commence, instead, to produce flowers and fruit. If a plant is provided with as much available nitrogen as it can use just at the time it begins to flower, the formation of flowers may be checked, while the activity of growth is transferred back to and renewed in stems and leaves, which take on a new vigor, and increase at the expense of fruit.

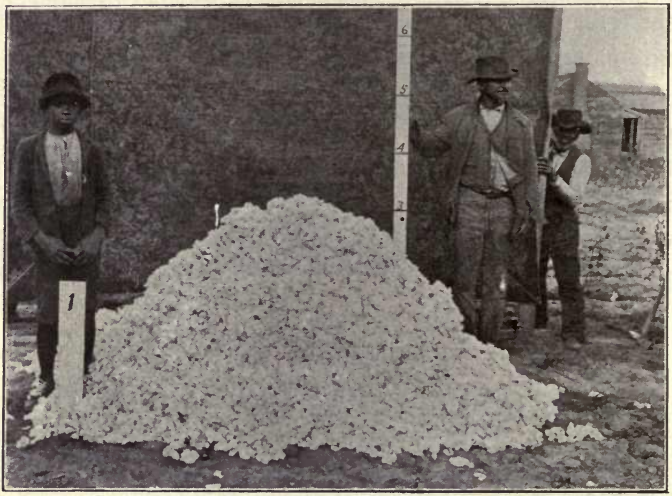
In the cultivation of cotton, the apparent action of nitrogen is principally to create a luxuriant foliage; that of potash to give strength to the framework of the plant and especially to develop the production of lint, while phosphoric acid regulates the maturity of the plant and develops the production of seeds.

LOSS OF FERTILIZER CONSTITUENTS FROM THE SOIL

Potash. It has been found by experience that potash does not wash through the soil to an appreciable extent, because it forms certain combinations in the soil which are not readily soluble in water, but which are, nevertheless, available as plant food. It may, therefore, be applied to the soil at the convenience of the farmer a month or more in advance of planting the crop.

Phosphoric Acid. Phosphoric acid also tends to form combinations in the soil which prevent leaching, nevertheless a loss occurs through the fact that it reverts into compounds which are less soluble and less available to the plant.

Nitrogen. So long as the soil is covered with vegetation the loss of nitrogen will be reduced to a minimum. On very light sandy soils, however, soluble forms of nitrogen, such as nitrate of soda or sulfate of ammonia, may



Not Fertilized. Yield, 1209 lbs. Seed Cotton per acre.
EXPERIMENT BY T. C. WILLOUGHBY, FLORENCE, S. C.

be washed from the soil. Care should therefore be used in applying them at intervals in two or more applications.

FERTILIZERS FOR COTTON

The cotton plant is a heavy feeder, demanding a soil well stored with readily available plant food. All forms of plant food must be soluble before they can accomplish

Completely Fertilized: 1500 lbs. per acre of a mixture containing 2 % Nitrogen, 6 % Phosphoric acid, and 8 % Potash. Yield, 2178 lbs. Seed Cotton per acre.

EXPERIMENT BY T. C. WILLOUGHBY, FLORENCE, S. C.

Incompletely Fertilized: 1020 lbs. per acre of a mixture containing 8% Phosphoric acid and 3 % Nitrogen. No Potash. Yield, 1962 lbs. Seed Cotton per acre.

EXPERIMENT BY T. C. WILLOUGHBY, FLORENCE, S. C.

any useful purpose. The roots are the organs of food absorption, more especially the fibrous roots, which branch off on all sides and do not seek low levels.

The object of fertilizing is to make good the losses of potash, phosphoric acids, and nitrogen taken up by previous crops, or losses by leaching, washing, etc., and to induce a larger production than before. The mere analysis of a soil forms no reliable guide to its effectiveness. A soil may contain large stores of potash, phosphoric acid, and nitrogen, and still fail to grow remunerative crops, simply because these natural supplies are in such a form as to remain insoluble, and thus resist all efforts of the plant to make use of them.

As a general rule, with but few exceptions, all fertilizers for cotton should contain the three essential ingredients—potash, phosphoric acid, and nitrogen, in proper proportions. The exceptions are:

(1) When the soil to be planted is "new ground" or "fresh" from the forest.

(2) When planting on low, moist, dark-colored bottom lands.

In each of the above cases there is usually present in the soil a good supply of nitrogen, as evidenced by the "weed" growing too luxuriantly and bearing its crop of fruit too late to mature. Therefore, a fertilizer containing a very small percentage of nitrogen, or none at all, would be required.

In all cases, the larger the amount of fertilizer to be applied per acre, the more important it will be to properly

proportion, or "balance," the three essential ingredients. If there be present in the soil enough phosphoric acid and nitrogen to produce three hundred pounds of lint per acre, but only enough potash to produce one hundred pounds, the crop cannot exceed the one hundred pounds. A chain is no stronger than its weakest link.

FERTILIZER FORMULAS FOR COTTON

It was once supposed that a careful analysis of a given soil would indicate correctly the character and composition of the fertilizer proper for such soil. But this supposition has not been realized, except to a very limited extent, in cases of peculiar soils and it is no longer relied on. It is conceded that actual field tests are reliable when properly planned and carried out. Many hundreds and perhaps thousands of such experiments were made at Experiment Stations of the Southern States in order to determine these questions and the results are not as divergent as might be expected from the fact that the Stations are located on soils of varying character and formation.

There is more promise of a needed guide in the knowledge of the chemical composition of the crop to be cultivated. We know that any given crop removes from the soil certain quantities of potash, phosphoric acid, and nitrogen; therefore, it seems reasonable to conclude that the return of these quantities of fertilizer ingredients to the soil will restore its normal fertility.

The following chemical analysis of a cotton plant is

taken from official sources and is thoroughly reliable. It is based on the growth of one hundred pounds of lint showing the amounts of plant-food elements removed from the soil.

	Potash.	Phosphoric Acid.	Nitrogen.
Roots (83 lbs.)	1.06	0.43	0.76
Stems (219 lbs.)	3.09	1.29	3.20
Leaves (192 lbs.)	3.46	2.28	6.16
Bolls (135 lbs.)	2.44	1.30	3.43
Seed (218 lbs.)	2.55	2.77	6.82
Lint (100 lbs.)	.46	.10	.34
Total Crop (947 lbs.)	13.06	8.17	20.71

It is evident from this analysis that a crop of 100 pounds of lint will remove from the soil 13.06 pounds of potash, 8.17 pounds of phosphoric acid, and 20.7 pounds of nitrogen. Yet the proportions found by analysis are not found to give the best results in actual practice; because account must be taken of the great losses that occur through heavy washing rains which remove plant food from the soil; also, that nitrogen is sometimes lost by the action of bacteria, as may be noticed in the decomposing manure pile, while phosphoric acid is likely to become "unavailable" in the soil through its tendency to take insoluble forms when brought into contact with lime and other materials existing in the natural soil. For this reason it is well to use more fertilizer than just what is shown to be needed by the chemical analysis of the crop.

After all, since not much reliance can be placed on the analysis of the soil and since the analysis of the crop cannot be relied upon implicitly, the actual soil-fertilizer test in the field is the best and most reliable guide to the composition of a fertilizer for certain crops and for certain soils. We must ask the soil, and also the crop to be grown upon it, what plant food ingredients and in what proportions they will give the best results. This question, answered by the soil and the crops themselves, serves admirably as a guide in computing a fertilizer formula for a particular crop on all soils of similar character and condition.

Bulletin No. 33 of the office of Experiment Stations, of the United States Department of Agriculture, recommends for cotton approximately seven hundred pounds per acre of a fertilizer having the following composition:

Potash	3	per cent.
Available phosphoric acid	9	" "
Nitrogen	3	" "

The Georgia Experiment Station, perhaps the most prolific in experiments of this character, recommends the following percentage formula for cotton on the average worn uplands of middle Georgia:

Potash	3	per cent.
Available phosphoric acid	10	" "
Nitrogen	3	" "

or potash 1 part, phosphoric acid $3\frac{1}{3}$ parts, and nitrogen 1 part.

A standard mixture of fertilizer materials which will

supply the three valuable ingredients in this latter proportion is as follows:

Muriate of potash	70	lbs.
Acid phosphate (14 per cent)	833	"
Cotton-seed meal	333	"
Nitrate of soda	100	"
Total	1,336	"

or, if one should prefer that the formula add up to one ton, then mix as follows:

Muriate of potash	105	lbs.
Acid phosphate (14 per cent)	1,245	"
Cotton-seed meal	500	"
Nitrate of soda	150	"
Total	2,000	"

These formulas are practical summaries of many combinations of fertilizer which have been fairly successful in actual field tests and are general formulas suggested for average conditions as nearly as can be determined. However, soils differ widely in different sections of the country, and a more detailed study of the treatment of soils is given below. The nature of the soil is not the only point to be noted in compounding a fertilizer. The previous cropping of the soil and its physical character are very important matters. If a rotation is practiced, it has a very considerable bearing on the fertilizer.

Light, sandy soils, those of the long-leafed-pine type, are usually very deficient in potash as well as nitrogen, and especially when worn and old. Therefore, the for-

mulas should be so modified as to carry relatively more potash and more nitrogen. This may be done by increasing the quantity of muriate of potash by fifty per cent or even more in some cases, and the cotton-seed meal by twenty-five to fifty per cent, but on light sandy soils that have been brought up by rotation of crops, green manuring and the use of horse and cattle manure, the nitrogen carrying ingredients, may be proportionately diminished by from twenty-five to fifty per cent. Therefore, for light sandy soils, the following formula is recommended:

Muriate of potash	102	lbs.
Acid phosphate (14 per cent)	642	"
Cotton-seed meal	636	"
Dry sand or earth filler	120	"
Total	1,500	"

This mixture would analyze about four per cent potash, seven per cent phosphoric acid, and three per cent nitrogen.

In case it should be desired to mix a ton of the above mixture, the following quantities should be used:

Muriate of potash	136	lbs.
Acid phosphate (14 per cent)	847	"
Cotton-seed meal	857	"
Dry sand or earth filler	160	"
Total	2,000	"

As the soils tone up from "light sandy" to those of the same type but of darker color and more loamy character, such as may be described as "sandy loams," "medium loams," and to the still higher type of "clay soils," the formula should more and more approximate to the stand-

ard of three per cent potash, ten per cent available phosphoric acid, and three per cent nitrogen.

Where the soil has been improved by rotation and renovating crops, the nitrogen may be reduced in amount, until at last but little of this ingredient will be required except a small amount of nitrate of soda (twenty-five to thirty pounds per acre), in the furrow with the seed for the purpose of giving the young plants a vigorous start.

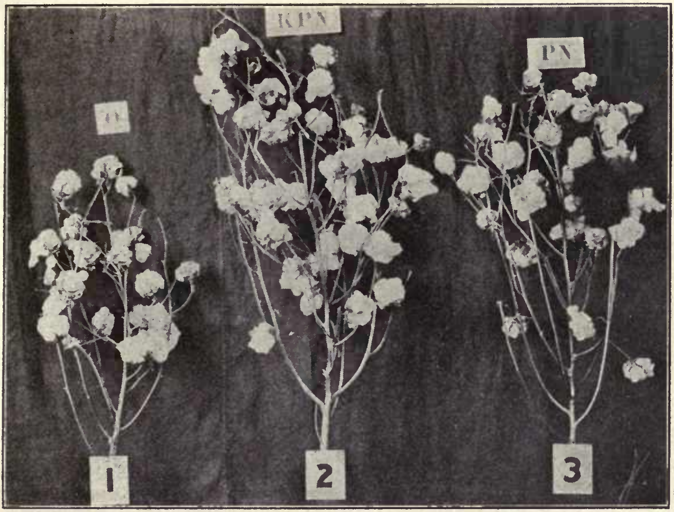
WHEN AND HOW TO APPLY FERTILIZERS

When the drill is used, distribute the fertilizer in a deep furrow, and mix it by running a scooter furrow through it. In very large applications, it will be a good practice to divide the quantity between the center furrow and the two listing furrows. The simplest method is to open a furrow and sow the fertilizer through the drill, covering with a harrow or bedding it on with a turn plow. If the weather is windy, it will be found advantageous to drop the fertilizer through a long tin tube and thus prevent it from scattering.

The best method of applying fertilizer is by the use of a machine distributor, drawn by a horse. There are several very good ones on the market, and they are great labor savers as they open the furrow, sow the fertilizer, and cover it up all in one operation. The plan is to apply about six inches deep through the drill and cover up so that the seed will lie about two inches above the fertilizer. The *seed should not come in contact with the fertilizer*, par-

ticularly when cotton-seed meal is the nitrogenous ingredient.

In applying fertilizers, bulk is often desirable, but it should always be borne in mind that, in purchasing, the object should be to secure as much potash, phosphoric acid, and nitrogen, in an available form, as possible for a



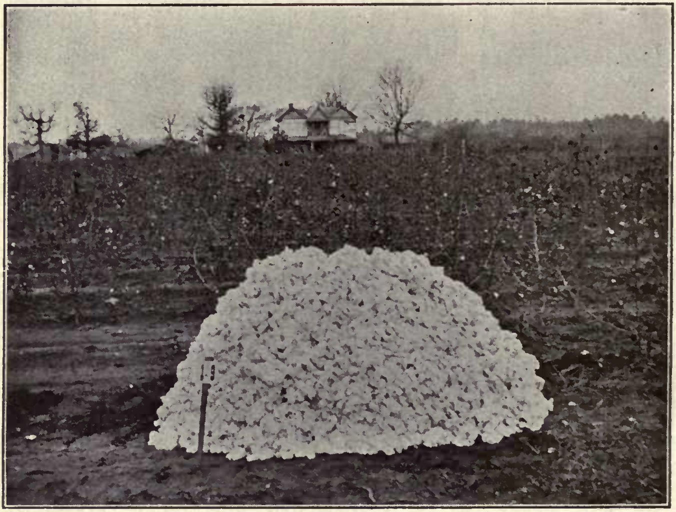
Unfertilized. 627 lbs. Seed Cotton per acre. Complete Fertilizer. (Potash as Kainit.) 1356 lbs. Seed Cotton per acre. Incomplete Fertilizer. (No potash.) 981 lbs. Seed Cotton.

FERTILIZER TEST BY J. M. CRUTCHFIELD, CULLMAN, ALA.

dollar, instead of as many pounds as possible of fertilizer, regardless of the amount of this plant food. Thus, it is more economical to purchase one ton of high-grade fertilizer than three tons of a low-grade fertilizer, for the reason that one ton of the former contains the same amount of

plant food as is contained in three tons of the latter; while, in making the latter, three times as many packages are required, three times as much freight must be paid, and the labor involved in handling is about three times as great.

Fertilizers should be finely ground and dry. When damp, they clog the drills and may start decomposition



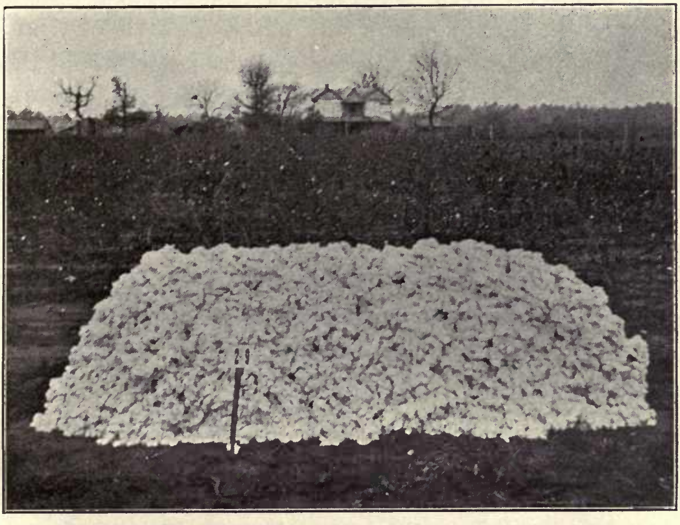
Fertilized with Acid Phosphate and Cotton-Seed Meal (No Potash).
Yield, 1230 lbs. Seed Cotton per acre.

EXPERIMENT BY J. W. TREADWELL, TALLADEGA SPRINGS, ALA.

too soon, so that, in many forms of organic matter, loss of ammonia results.

Concentrated fertilizer chemicals may be increased in bulk by mixing with dry earth or sand, and such mixing

will make an equable distribution easier. Materials, not readily soluble in water, such as stable manure, cotton seed, bone meal, etc., should be applied to the soil some time before planting, say not less than two weeks; potash and acid phosphate should also be applied early. Potash may be applied to advantage several weeks before planting time and without danger of loss, except in the case



Completely Fertilized. Kainit, Phosphate, and Cotton-Seed Meal.
Yield, 1992 lbs. Seed Cotton per acre.

FERTILIZER TEST BY J. W. TREADWELL, TALLADEGA SPRINGS, ALA.

of very light sandy soils which contain little organic matter. If application of the fertilizer has been delayed until the crop has commenced to grow, care should be taken that it does not come in actual contact with the foliage.

On soils of loose texture and small retentive power, it is best to apply at time of planting and to use, for the most part, fertilizers containing nitrogen in a form which is not too easily soluble, in order to make losses occasioned by heavy rains as small as possible. Animal and vegetable ingredients are especially suited for such cases.

Fertilizers containing ammonia compounds should not be mixed with wood ashes, lime, or Thomas slag (odorless phosphate), since some of the ammonia is likely, under such conditions, to be liberated and lost; nor should these substances be mixed with acid phosphate, because they render the phosphoric acid less available.

Intercultural Fertilizing. The application of fertilizers during the growing period of the crop is quite plausible in theory, but its wisdon is not confirmed in actual practice. This is especially true in regard to phosphates and potash salts. These do not leach out of the soil to any considerable extent and they require considerable time to get into condition to be effective. It is permissible and advisable to make one or more intercultural applications of readily soluble nitrogenous ingredients such as nitrate of soda and sulphate of ammonia, especially in case the fertilizer applied at the usual time (before planting) was deficient in nitrogen. For this purpose, nitrate of soda is probably the most desirable. A small quantity, say twenty-five or thirty pounds per acre, applied to the furrows with the planting of seed, or scattered along on the surface immediately above the covered seed, increases the strength and vigor of the young cotton plants.

Experience seems to indicate that these intercultural applications of nitrate of soda should not be deferred until a later period than about the time the blooms commence to appear and never in larger quantities than one hundred pounds per acre at any one time.

FERTILIZING MATERIALS FROM THE FARM

In order to use farmyard manure to the best advantage on the average soil, it must be supplemented with commercial fertilizers containing available phosphoric acid and potash. As a general rule, with every ton of stable manure applied, there should be from fifty to one hundred pounds of acid phosphate and from twenty-five to fifty pounds of high-grade muriate of potash or sulfate of potash.

In rotted manure the fertilizer constituents are, as a rule, more readily available for the use of plants. Rotted manure is less bulky and more easily distributed than fresh manure. It is also less likely to promote the too-rapid growth of stems and leaves as in the case of fresh manure. For the improvement of the mechanical condition of a soil, the best results will be obtained by using rotted manure on light soils. It must, however, be remembered that on such soils there is more or less danger that some portion of the valuable fertilizing constituents may be leached out and lost. On this account it has been found advisable to apply such manure to light soils only a short time before it is needed by the crop, and the spring is usually the right time to apply such rotted manure. In warm, moist climates, it matters less whether the manure

is applied in a fresh or rotted condition. In cold, dry climates, however, the use of decomposed manure is much preferable.

The following three methods of applying manure on the field are in common practice, viz.:

Applying in Heaps. By this method the manure is distributed in heaps over the field and permitted to stand some time before being spread. This method is objectionable for several reasons. The labor of handling is increased; there is danger of loss from decomposition and leaching; the manure is not uniformly distributed, the spots immediately beneath the heaps being more thoroughly manured on account of the leaching. Storing manure in very large heaps is less objectionable, provided the heap is carefully covered with earth, kept moist, and not allowed to stand too long.

Applying Broadcast or in the Rows. When the crop is one that is grown in rows, as is the case with cotton, also corn, drilled peas, sugar cane, sorghum, etc., the fertilizer should be deposited underneath the rows and bedded on, although where large amounts are to be applied, it is safer to broadcast the excess above the ordinary amounts supplied in the rows, in just the same manner as with crops which grow broadcast; as, for instance, the smaller grains (not planted in drill), cow-peas, grasses, etc. Repeated experiments at the Georgia Experiment Station have resulted in securing double the increased yield of cotton where one thousand pounds of concentrated fertilizers were applied in the cotton rows as compared with the increased yield

from the same amount applied broadcast over the same surface and plowed in, etc. The fertilizer should be applied deep enough to avoid the drying-out effect of a severe drouth, and no definite rules can be laid down as to the exact depth to which fertilizers should be applied since this will depend upon the depth of the soil and local conditions as to drainage, etc.

NATURE OF FARM-MADE MANURES

Stable and farmyard manure consists of the solid and liquid excrements of animals fed on the farm, the excrements being usually mixed with straw and waste products of the farm.

Horse manure is difficult to mix thoroughly with litter on account of its dryness. It is called a "hot" manure. On account of its loose texture it easily undergoes decomposition or fermentation, producing a high degree of heat. Horse manure is very liable to lose more or less of its nitrogen by the escape of ammonia.

Sheep manure is quite dry, and is commonly the richest of farm-produced manures. Like horse manure, it undergoes fermentation easily, and is classed as a "hot" manure. It is also very liable to lose ammonia.

Pig manure varies greatly in composition, but is generally rich as compared with other farm-produced fertilizer materials, yet contains considerable water. In decomposing, it produces but little heat, and is therefore called a "cold" manure.

Cow manure contains, as a rule, less fertilizing mate-

rials than any of the above-mentioned manures. It has a large percentage of water, and, in decomposing, generates but little heat.

Poultry manure contains a comparatively large amount of all the different forms of plant food, being especially rich in ammonia and phosphates. It undergoes fermentation readily, and loses ammonia unless properly treated with absorbents or preservatives.

AVERAGE COMPOSITION OF THE MOST IMPORTANT FARM MANURES.

Manures.	Potash.	Phosphoric Acid.	Nitrogen.	Lime.
	(K_2O)	(P_2O_5)	N[1]	CaO
Cow manure (fresh) ...	0.40	0.16	0.34	0.31
Horse " " ...	0.53	0.28	0.58	0.21
Sheep " " ...	0.67	0.23	0.83	0.33
Hog " " ...	0.60	0.19	0.45	0.08
Hen dung " ...	0.85	0.54	1.63	0.24
Mixed stable manure ..	0.63	0.26	0.50	0.70

As a rule, manure produced from working or fattening animals contains from ninety to ninety-five per cent of the fertilizing constituents contained in the food of these animals. Manure made from cows in milk, and from young growing animals contains from seventy-five to eighty-five per cent of the fertilizing constituents contained in the food. In the case of animals which are neither increasing in weight, nor giving milk, the amount of fertilizing materials in the manure will be nearly equal to that contained in the food eaten. The foregoing state-

ments presuppose that all the dung and urine are saved, a supposition which is not often true, considering the manner in which stable manure is commonly treated.

Perhaps the element of manures least understood is the humic matter, of which ordinary manure contains from six to ten per cent. The litter used in bedding stock furnishes much of this, the quantity depending upon the nature of the material used.

PROPER CARE OF FARM-MADE MANURES

Farm-made manures suffer loss from leaching or washing away of the soluble fertilizing ingredients and from chemical decomposition. Losses from leaching may be checked by building a covered manure shed, and by the use of ample supplies of bedding material. If plenty of bedding material is used, it will absorb the liquid portions of the manure, and thus, in a large measure, prevent the loss of large amounts of plant food contained in the urine. In disposing of stable manure the modern method is to be preferred, as it not only saves much labor of handling, but there is less loss of valuable nitrogen from over-heating (fire-fanging). It consists in hauling the green or partly-rotted manure directly to the field, spreading it and plowing it under. This method does not entirely obviate the necessity of storing the manure as it comes from the stalls under a shed, where it may be occasionally wetted with water to prevent over-heating. Kainit, or acid phosphate, may be sprinkled over the manure in the stalls,

or under the manure shed, in order to "fix" the ammonia and prevent its escape in the form of gas.

PLANTING THE SEED

Width of Rows and Spacing. It has already been elsewhere suggested that the width of cotton rows should not be greater than three to three and a half feet on soil capable of producing one bale or less per acre. As the soil increases in natural productive capacity, or is improved artificially so as to produce a crop of two bales per acre, the rows should be proportionately wider. On the ordinary worn uplands of the South, not capable of a yield exceeding one-half bale per acre, three feet between rows is wide enough. With a possible yield of one to one and a half bales, the width should be three and a half to four feet. On rich low grounds and on the rich black soils of the Gulf States, greater width may be found desirable or necessary.

Spacing in the Rows. Experiments repeated through a period of five years at the Georgia Experiment Station show that the best results in cotton production are secured by spacing the plants as nearly "on a square" as other considerations will permit. With plants in three-foot rows and two feet apart the yield was always larger than when they were in four-foot rows by one and a half feet in the row; and the yield of the last was greater than when the rows were five feet and the plants fourteen and four-tenths inches. The lowest yield was where the rows were

six feet wide and the plants one foot apart. In all these cases the space assigned to each plant was exactly equal, being six square feet. It was also noticeable that the percentage of a full stand was higher in proportion as the plants were more nearly "on a square."

From other carefully conducted experiments it is safe to conclude that, with one plant to every four square feet, the yield will be greater than from any larger plant area, and that the four square feet should approximate a square shape as closely as consideration of increased cost of cultivation may permit. With rows three feet wide this area of four square feet would be secured by having one plant every sixteen inches.

It should be borne in mind that the soil upon which the experiments were performed was typical middle-Georgia "upland," brought up from a worn, almost-exhausted, condition to a yield of one to one and a quarter bales of cotton per acre with the aid of judicious fertilization and rotation. On similar soils not so improved, but capable of a yield of one-half bale per acre (aided by fertilizers), the rows should be three feet wide and the plants spaced at ten to twelve inches in the rows. It is well to bear in mind that *an imperfect stand, either from frequent missing places, or from too wide spacing, is one of the commonest faults of upland-cotton culture and probably causes a greater loss than does any defect of cultivation.*

Varieties. There is practically "no end" to the number of so-called varieties of cotton, very few of which possess any distinctive and peculiar characteristics. King's Im-

proved, a very early variety, is probably the most distinct and persistent type in common cultivation, and is the parent of dozens of other sub-varieties differing, chiefly or entirely, only in name. The early varieties, of which King is the type, are to be recommended for planting in high latitudes and altitudes, or "fresh" lands, low-lying bottoms, or whenever late planting is necessary.

Experiments at the stations show that in the heart of the cotton belt a medium or even a rather late variety, under ordinary conditions, will give better results three years in four than will the very early variety.

The ideal variety is the one that has a strong, vigorous stalk, medium to large bolls, and that continues to grow and bear until late in the fall. It is advised that every farmer should be guided by the variety tests at the several stations. It may be well to add that for several years past, there has been an increasing demand for upland long staple from mills engaged in producing certain grades of goods requiring a longer fiber than is afforded by the common upland short staples, and it may prove a wise thing to meet this demand. It is unfortunately true, however, that the upland long staple varieties are much less productive in pounds of seed cotton and particularly in the percentage yield of lint. To prove equally profitable, the upland long staple should command a price from twenty-five to fifty per cent higher than the short staples.

Selection of Seed. Every intelligent cotton grower should devote much care to the annual selection of seed, with the view to maintaining and increasing the product-

iveness and other desirable qualities. The following on this subject is taken from Bulletin No. 75 of the Georgia Experiment Station (1906):

"In the early fall every farmer should make careful selections of the best bolls from the plants he judges to be the best. The seed cotton from each of these bolls should be placed in a separate package, and given a number to correspond with the plant which produced it. The total product of each plant should likewise be separately preserved, noting the number of bolls as well as the total weight, and finding out the percentage yield of lint. Having now all the facts attainable in regard to each plant, it will be easy to determine approximately which is the best plant, and to plant the seed from the reserved first-selected bolls under the most favorable conditions. The operation should be repeated every year, using the main product of the best stalks to plant a seed patch, and the seeds from the few selected first-choice bolls to plant the next breeding patch."

The possibilities of the improvement of our varieties of cotton are very large. There is no known reason why the size of bolls, the percentage yield of lint, the length, fineness, and strength of the fibers may not be greatly increased by careful selection and cross-breeding. Why not increase the size of the bolls to "16 to 1" or until each boll shall yield one ounce of seed cotton? Why not increase the percentage yield of lint until it shall average fifty per cent or higher?

Possibly, if all the money and energy that have been

expended to invent a cotton harvester had been expended in diligent efforts to increase the size of the bolls, the problem of harvesting the cotton crop would have been solved. With bolls weighing one ounce, a smart laborer might "pick," in the ordinary way, one thousand to fifteen hundred pounds of seed cotton in a day.

Method of Planting. (The Seed Bed.) Under the head of "Bedding the Land," the method of making this final preparation for the reception of the seed has been given. It is important that the seed be deposited in a fresh, smooth, moist bed, which may be secured by harrowing down (if necessary) and boarding off the beds, using for this purpose a two by ten-inch board, five to six feet long, a pair of shafts attached, and, drawn by one horse, striking off two rows at the same time. This should be done immediately in advance of the planting machine. This machine should be adjusted so that the seed will be about one inch below the surface when the latter is pressed down, or one and one-half inches if a ridge of loose soil is left by the coverer. At this time, in order to give the young plants a good start, the twenty-five to thirty pounds of nitrate of soda per acre may be applied, either in the furrows with the seed (if the machine will do it) or on top of the covered seed by hand.

Time for Planting. Cotton planters may have many local rules to determine the proper time for planting. The blooming of the dogwood is one of these rules, and another is, "ninety days from when the 'katydid' is first heard." Neither of these is at all reliable as a guide to

planting. The best rule is to plant at or about the date which long experience has proved the most satisfactory, provided only, that the soil shall be in workable condition, or not "too wet to plow." This date will, of course, depend upon the latitude and altitude, varying from March 1st in southern Texas and Florida to May 20th in upper North Carolina, southwest Virginia, southern Missouri and Kentucky.

CULTIVATION

The first step after planting may be to run over the field with either an ordinary smoothing harrow with the teeth slanting backward, or the more modern weeder—a very effective implement—running directly across the rows or diagonally. If the seeds come up promptly before a rainfall, the work may well be deferred until afterward. But if a heavy rainfall shall occur before the seeds germinate the work of the harrow or weeder will be very effective in preventing or destroying the crust that usually forms after such a rain and which might prevent the tender plant from coming to the surface. At the same time, sprouting seeds of grass and weeds will be destroyed even before they appear. This surface harrowing may be repeated two or more times, before the use of any other cultivating implements will be necessary.

"Chopping Out" should commence when the seed leaves are fully expanded and the third and fourth leaves have commenced to enlarge. It should be done rapidly,

striking but one blow in the same place and reducing the plants to bunches, ten to fifteen inches apart, of two to four plants. The "hands" should be able to cover two to three acres where rows are three and one-half feet apart. The cultivator should follow rather closely after this chopping, and the final work of "putting to a stand" should be commenced within a few days after the chopping has been finished. At this juncture the presence of "the boss" or some reliable representative is absolutely necessary in order to see that the work is properly done and the stand preserved. If this be properly performed, and the plowmen do their duty afterward, very little further work with hand hoes will be necessary. The further work of cultivation should be done with shallow running sweeps, scrapes, or, better still, regular cultivators running once or twice to the row, every week or ten days, the main purpose being to keep the surface to the depth of one or two inches, as nearly as may be, in a loose and open condition.

The effect of this layer of loose pulverized soil is to prevent undue evaporation and loss of moisture from the soil, as well as to destroy grass. As a rule, all horse-implement cultivation should cease when the cotton plants have expanded laterally until the limbs nearly meet in the middle, which is by July 1st to August 1st, depending upon the location of the plantation. Continuing the cultivation too long tends to produce "weed" at the expense of lint.

During the first period of the development of the cot-

ton plant, from middle spring to middle summer, it makes the growth of stalk and leaf, and gathers nourishment for the future elaboration of seed and lint. This is the fruiting season. The energies of the plant are now directed toward making use of the materials it has already accumulated, and the growth of foliage diminishes. The planters assist the plant by reducing its supply of water, through promoting surface evaporation; the soil remains undisturbed, and gradually dries. It is precisely reversing the process desired in the earlier stage of growth.

The practice of sowing crimson clover between rows (about fifteen pounds per acre), immediately after the last working, is growing in favor. The effect of this is to cover the ground with a mat of vegetation which checks winter washing. It also makes a valuable green manure for turning under. Crimson clover is an annual, and for forage purposes requires re-seeding each year.

HARVESTING AND MARKETING

Picking. The ripening of cotton naturally depends on the climate or location. The first bolls open about May 15th in southern Texas; June 25th in middle Texas; July 1st in southern Louisiana; July 10th in middle Louisiana; July 15th in southern Georgia and pine-hill section of South Carolina; August 1st in northwestern Louisiana, southern Arkansas, and coast of North Carolina; September 1st in the Piedmont region, North Carolina, and the

red loam prairies of Texas; and September 15th in northern Arkansas.

Picking commences about July 10th in southern Texas; August 1st in southern Louisiana and central Texas; August 15th in the pine hills of South Carolina and coast of Georgia and South Carolina, and Mississippi uplands; August 25th in northwestern Louisiana and Mississippi bottoms; September 1st in northern Texas, coast of North Carolina, and northwest Georgia; and October 1st in northwestern Texas and northern Arkansas.

The cotton field is usually picked over three times; in the Gulf States the first picking takes place in August and September, the second in October, and the third in November and December. In Georgia, North and South Carolina, Texas, and Arkansas, the first picking usually takes place in September, the second in October, and the third in November. As cotton gins badly when wet, picking is not commenced in the morning until after the dew is off the bolls, nor should it commence soon after a rain.

Picking has thus far been entirely a hand process. No satisfactory picking machine has yet been widely adopted. The price paid for picking ranges from thirty to fifty cents per hundred pounds. A fairly expert picker should harvest three hundred pounds per day, but in practice the average is little over one hundred pounds. The planter should prepare beforehand for harvesting his crop, as the cotton must be picked as soon as properly opened, to prevent losses from soiling, falling out, etc. Cotton left

in the field for a fuller opening than an average of two hundred pounds per acre is liable to serious damage, and, in case of storms, to almost total loss.

Ginning. The removal of the seed from the lint, ginning, is now generally done by public steam gins. The charge is very low, and it is cheaper than home-ginning. Some of the large plantations have their own gins. Packing or baling follows the ginning, and the modern cylindrical bale closed in cotton duck, sewed instead of iron-tied, is an improvement on the old style badly-made burlap bale. In the matter of ginning and baling, the planter is generally at the mercy of his local steam gin. If it is a modern plant, he is very fortunate; if not, the only remedy is to endeavor to have a modern plant established.

Marketing. The cotton crop is seldom marketed by the planter direct. The custom is to haul it to the nearest market town, where the bales are consigned to a factor, or commission man, who furnishes storage and insurance, samples each bale and sells its contents, making a fixed charge for his services. By this system, the cotton passes through several hands, each of which makes a handsome profit. It is wrong in principle, and the remedy lies in a thorough organization of planters. Under present conditions, it is generally more profitable to sell direct from the gin, and save cost of storage, insurance, and loss from shrinkage.

DISEASES OF COTTON

In the treatment of cotton diseases an ounce of prevention is worth many pounds of cure.

YELLOW-LEAF BLIGHT

This is also known as the "Mosaic disease." The later stages of this disease are commonly known as "black rust." The leaves take a yellowish color, followed generally by an attack of fungus, which forms brownish spots, finally becoming black. If dry weather continues for a long period, the leaves curl and fall.

Remedy. The disease is probably due to lack of proper nutrition. The preventive is liberal fertilizing. Experiments conducted by Prof. George F. Atkinson, showed a considerable reduction of the disease from the use of kainit applied as a fertilizer. Professor Atkinson also conducted experiments at Auburn, Alabama, which confirmed the view that liberal fertilizing with mixtures containing kainit is an effective preventive. The action of the kainit in conserving soil moisture is believed to have no little weight in protecting the plant from the blight.

RED-LEAF BLIGHT

On this subject the following is quoted from "The Cotton Plant": "The foliage of cotton frequently presents a red coloration, which is of the same nature as that displayed in 'autumn leaves.' It is especially common on

KAINIT AS A PREVENTIVE OF COTTON RUST

No Fertilizer. Badly Rusted.

TEST BY L. S. WHITE, SUMMIT, MISS.

Fertilized with 165 lbs. Kainit per acre. Free from rust.

TEST BY L. S. WHITE, SUMMIT, MISS.

what are known as 'uplands,' where the soil is worn and poor. When it occurs early in the season, the cotton sometimes makes but little progress before the leaves turn red, growth ceases, and early maturity sets in, and the leaves drop, while the plant bears from one to two or several bolls."

Remedy. The same authority says: "It results from an impoverished condition of the soil, showing a lack especially of potash and nitrogen, and probably also of phosphoric acid. This can be remedied by proper fertilizing and cultivation."

SHEDDING OF BOLLS

This is the most serious of cotton diseases. It occurs most frequently in extreme wet or dry weather, or during a change from one extreme to another. It may develop under normal conditions, especially if the cotton plants are very thick, or the variety is one which develops a very large amount of fruit in proportion to the leaf surface.

Remedy. The authorities give no definite remedy. The disease seems to be influenced by the power of the plant to assimilate nourishment. It is quite probable that this disease, like the yellow and red leaf blight, is a result of imperfect fertilization. Thorough tillage should have much influence in checking the disease, from its value in preventing irregularities in soil water.

FRENCHING

The first sign of the disease is usually a light yellowing of the lower leaves at the edge, or more commonly between

the forks of the main ribs of the leaf. The yellowing is sometimes nearly white, and is the result of a failing nutrition of the leaf. At an early stage of the disease the leaves begin to brown at the point at which the yellowing first appeared; then they die and fall. In sandy land the disease makes rapid progress; very few of the leaves may show the color, but on a hot or dry day, they suddenly wilt.

Remedy. The authorities give no specific remedy. It is a fungus disease, and may be checked by liberal fertilization accompanied by clean and thorough cultivation. If very severe, a rotation must be practiced to free the soil of infection.

SORE SHIN

This is also known as "Damping off," and "Seeding rot." It is a fungus disease, favored by excessive rainy weather during the early stages of growth. It appears in large plants which have been injured by bruising through careless use of cultivators, etc. The best checks are drainage and cultivation. Care in working the soil will protect the larger plants.

ANTHRACNOSE

This disease attacks principally the bolls, but also infects stems and leaves. The accompanying cut indicates the nature of the diseased bolls. The disease originates in minute spots of a dull reddish color which soon give place to a blackening of the tissue as the spot enlarges.

Remedy. The remedy so far as is known is confined to preventing the spread of the disease. Treating seed, which may be infected, with hot water or corrosive sublimate solution may prove useful. Never use seed from cotton in an infected field. Improving the vitality of the plant by rational fertilization and cultivation is the best preventive.

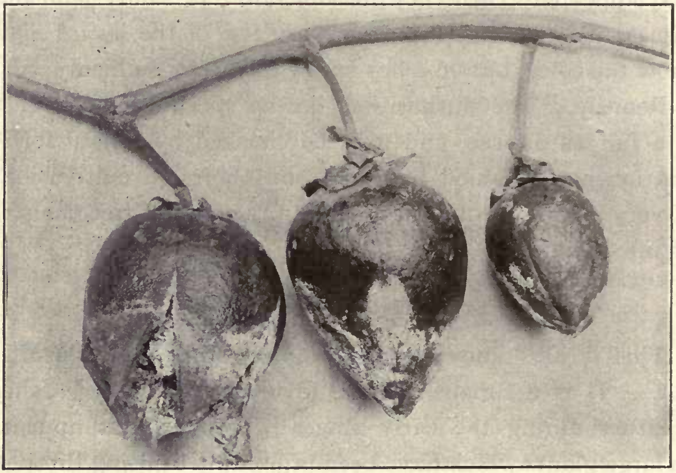


Photo by Wilmon Newell.*

COTTON BOLLS AFFECTED WITH ANTHRACNOSE.

ROOT ROT OF COTTON

The first indication is the sudden wilting of one or more plants, usually first noticed late in June or early in July. The fungus derives its nourishment from the living substance of

*Courtesy Georgia State Board of Entomology.

the root, and the result is the death of the plant from starvation and lack of proper water supply. Examination of the plant shows a mat of fungus adhering to the roots. Wet weather is favorable to its development.

Remedy. There is no remedy, but the same preventive measures may be employed as are used with the other fungus diseases, namely, liberal fertilization, with thorough drainage and tillage. Infected plants should be pulled up and *burned.* Green manuring, or the use of farmyard manures, should be suspended. Rotation of crops is advisable, with corn, sorghum, millet, wheat, oats, and other members of the grass family. On infected soil cotton should not be planted oftener than every third or fourth year, until the disease is eradicated.

Black Root Disease or Cotton Wilt.*

COTTON-LEAF BLIGHT

This is a very common disease of the cotton plant. The accompanying illustration shows the nature of the disease.

* Courtesy Georgia State Board of Entomology.

It usually attacks only the older leaves, or those which have been weakened from other causes. The disease shows in rounded, irregular spots on the leaf, which have a dull reddish border surrounding a whitish or brownish interior. As the spots become old, the central portion frequently breaks out, leaving the leaves with a perforated and ragged appearance.

Remedy. The trouble is starvation and bad soil conditions; the remedy is obvious. Kainit is claimed to be an almost perfect specific for the disease.

COTTON-BOLL ROT

This disease affects the boll, seed, and lint. It appears to originate within the boll and is not perceptible until the contents of the boll have become decayed. The disease is chiefly confined to the middle and top crop.

Remedy. The remedy, as with all diseases of this kind, is liberal manuring and a rotation of crops. The disease resembles Frenching in many characteristics.

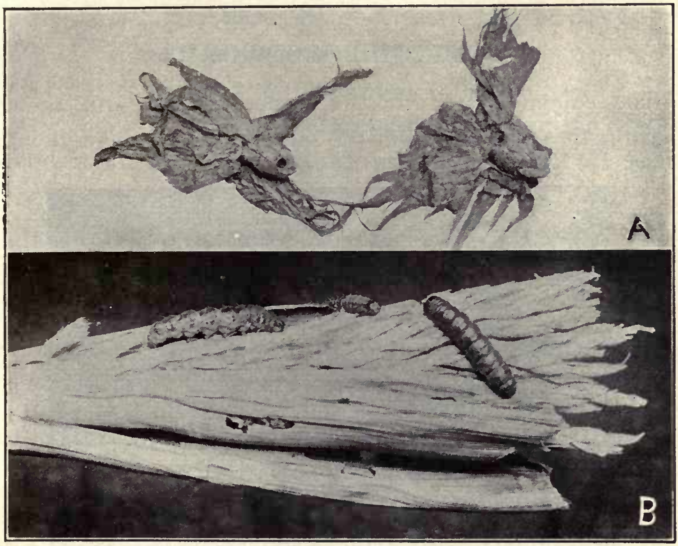
ROOT GALLS

This is a disease caused by a nematode which, living in the tissues, causes abnormal growth, termed "galls." The injuries caused by the distortion of the roots so drain the vitality of the plant that putrefaction takes place. The plant becomes vitiated, and falls an easy prey to many diseases.

Remedy. Rotation of crops is effective. Kainit applied in liberal quantities is an aid in checking the disease.

INJURIOUS INSECTS

It is stated on good authority that the average loss to cotton growers from the ravages of a single species of insect is estimated to amount to $15,000,000 annually.



A, showing damage by cotton-boll worm. *B*, cotton-boll worm.

COTTON-BOLL WORM.

The fight against these insects must be carried on in a vigorous manner. The remedies should be studied carefully, and the application carried out to the smallest detail.

THE COTTON WORM

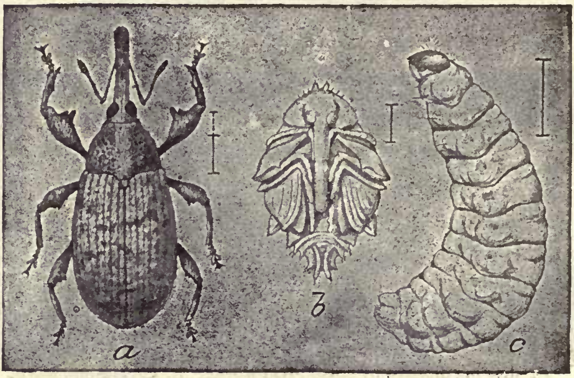
This is also known as the cotton caterpillar. The insect is too familiar to cotton growers to require description.

It attracts attention chiefly from the ragged condition of the leaves.

Remedies. The most effective method of treating plants is to dust those infected with dry Paris green. Spraying with liquid insecticides is also effectual.

COTTON-BOLL WORM

The cotton-boll worm, the corne-ar worm, and the tomato-fruit worm are all of the same family. The following



A, adult stage. *B*, pupa stage. *C*, larvæ stage.

THE BOLL WEEVIL (ENLARGED).

illustration shows the larvæ stage of the boll worm. Full-grown worms may be found in almost every intermediate stage of color, from light green and dark brown to rose. They may be striped and spotted, or they may possess dark stripes or black spots.

Remedy. Plant a few rows of cow-peas as a trap crop,

bordering the cotton. They are to be planted late, so that blooming will not occur until the destructive brood appears, usually in August. A portion of the row should be sprayed over every night with a mixture of four ounces of beer and two ounces of potassium cyanide. Trap crops have been found the most effective means of fighting the worm. Plant five rows of early maturing sweet corn to every twenty-five rows of cotton. The silk ends of this corn should be cut off and destroyed by burning, and the corn plants removed. Three rows of dent corn are planted so that the silking period will occur about July 1st, or a little later. These rows are to be allowed to mature, as they will attract the moth from the cotton, and the worms will be destroyed by parasites.

THE BOLL WEEVIL AT WORK.

MEXICAN COTTON-BOLL WEEVIL

This is a small grayish weevil measuring a little less than a quarter of an inch in length. It is found in the cotton fields throughout the season, puncturing and laying its eggs in the squares and bolls. The squares attacked usually drop, but the bolls either dry or rot.

The boll weevil is the most destructive insect enemy known to the cotton plant. Its ravages at present are confined to the Western part of the cotton-growing area, but it is

presumed that, within a few years, the insect will spread over the whole cotton-growing territory.

Remedies. The best remedies are the destruction of the insects where possible and bringing the cotton to an early maturity, so that a large part of the crop may be harvested before the weevils have greatly multiplied.

The cotton stalks should be burned and in the fall all rubbish and fallen squares should be picked and destroyed as fast as practicable.

For planting, early varieties should be chosen, and it is very important to hasten the process of maturing the cotton by the liberal use of fertilizers.

MINOR INJURIOUS INSECTS

Cut Worms. Cotton is sometimes injured by cut worms, particularly if a clover sod has been turned under for the crop. The worms may be destroyed by making bundles of green grass, turnip or cabbage leaves, thoroughly dusting them with Paris green, and distributing the bundles over the cotton field in the evening. Grass may be thoroughly sprayed with any powerful insecticide, cut and spread over the cotton field in small heaps.

Leaf-Feeding Caterpillars. Spray with Paris green, or dust it on dry. This remedy applies to all caterpillars of the leaf-feeding habit. Grasshoppers of the same habit are trapped by attracting them to small patches of sweetened bran, poisoned with arsenic.

COTTON PLANTERS MUST USE CHEMICAL FERTILIZERS

There is no doubt that cotton planters must use chemical fertilizers if they want to raise good, paying crops. The plain question may be and is often asked: Does it pay to use chemical fertilizers? Our answer to this question is summed up in one word: "Yes!" The time has now come when the great majority of planters in the cotton belt must use chemical fertilizers if they hope to succeed and make any profit. In fact the most successful cotton planters to-day are those who buy and use the most fertilizers.

The best answer as to the value of chemical fertilizers for cotton may be found in a bulletin issued by the United States Department of Agriculture (Misc. Series, No. 13, Division of Statistics). This bulletin contains the results of tests in ordinary field practice by 1,495 planters. The results are summarized as follows:

"It appears that there were twenty-one planters who spent less than $1 each per acre for fertilizers, and that their average profit was $4.62 per acre. The planters who spent from $1 to $1.99 per acre had an average profit of $5.09 per acre; those who spent from $2 to $2.99 per acre had an average profit of $5.34; those who spent from $3 to $3.99 per acre had an average profit of $5.91; those who spent from $4 to $4.99 per acre had an average profit of $7.96; those who spent from $5 to $5.99 per acre had a profit of $8.76; while the planters whose fertilizers cost

them $6 per acre and over had an average net profit of $12.51 per acre.

"It will thus be noticed that the increase of expense for fertilizer in cotton raising apparently leads to increased profits; and further, that so far as these results disclose, the point of diminishing returns was not reached in the total for the five States (South Carolina, Georgia, Florida, North Carolina, and Alabama) that are included, and where it was reached, apparently, in any State, the result is probably a chance one due to the small number of returns.

"The planters who lost did so because of more or less crop failure due principally to drought, in which case, as is well known, the full value and effect of manures or fertilizers can not be shown; there is, however, little actual loss, as the plant food is largely retained in the soil for the next season's crop. Had these crops been raised under normal conditions, losses would have been gains, although not necessarily equivalent ones."

Additional official evidence is furnished from testimony obtained by a Congressional Committee (Agriculture and Forestry) appointed to examine into the conditions of cotton planting. A report was made to this Committee from Beaufort County, N. C., stating that about ten per cent of the land in that district would produce five hundred pounds of lint cotton per acre if fertilized. From Barnwell County, S. C., an answer to the Committee's circular letter states: "There is from thirty per cent to fifty per cent profit in the use of fertilizers, depending on the grade and the land. Without fertilizers we would have to quit planting cotton."

COST OF MAKING COTTON

The cost of producing a pound of cotton depends on so many contingencies that all calculations are more or less misleading and of little service to the practical farmer or to the student of agriculture.

The actual fixed expenses vary considerably in different farms and under different managements. They may vary from $12 to $20 per acre. At any given figure for fixed expenses the cost per pound of cotton will vary inversely as the yield per acre. Practically, it costs as much to cultivate a poor acre as it does to cultivate a rich acre, the difference being in rental value. It costs some farmers fifteen cents per pound of lint; others, twelve, eight, and so on down to five cents. At the lower figure (five cents), naturally rich, highly improved, and liberally fertilized land would be required, also, the best seed and the most skillful cultivation.

Possibly the average cost of producing lint (at present, 1909), is around eight cents per pound.

It is quite certain that the use of a well-balanced fertilizer is an indispensable aid in producing cotton on ordinary soils at a low cost. Eight hundred pounds, or about $10 worth, of a properly balanced high-grade fertilizer may, under favorable conditions, cause an increase of eight hundred pounds of seed cotton or two hundred and sixty pounds of lint, worth (at ten cents) $26.60, and five hundred and thirty-four pounds of seed, worth (at eighty cents per cwt.) $4.27, making a total of $30.87. Even in

an average year the increased yield may be as much as $20 for each $10 worth of fertilizer, or one hundred per cent profit. At the present (1910) high prices of cotton the average profits are much larger.

GENERAL REMARKS ON FERTILIZERS

As several crops of different kinds may be grown in rotation with cotton, it may be useful to give a general review of the best fertilizer practice. All the crops making part of a rotation must be fertilized, except when a cow-pea, clover, or other leguminous crop is raised. While nitrogen may be secured indirectly as a part of a rotation system through a special property of leguminous crops, potash and phosphoric acid must always be applied direct. It is well known that different crops need different quantities of potash, phosphoric acid, and nitrogen compounds. If we cannot depend upon the soil to furnish any considerable quantity of plant food, then the farmer must use, at least, the amounts of fertilizing materials removed by each crop. In the following table we give the number of pounds of potash, phosphoric acid, and nitrogen used by different kinds of crops grown on one acre of land.

Table giving the Amounts of Fertilizing Ingredients (Potash, Phosphoric Acid, and Nitrogen) Contained in the Crop for One Acre.

Crop.	Yield.	Straw, Etc.	Potash.	Phosphoric Acid.	Nitrogen.
Beans	30 bu.	2,700 lbs.	30 lbs.	30 lbs.	75 lbs.
Cabbage	30 tons	....	270 "	70 "	198 "
Clover,* green	....	15 tons	140 "	40 "	129 "
Clover, dry ..	....	2 "	88 "	18 "	81 "
Corn	70 bu.	6,000 lbs.	55 "	48 "	82 "
Mixed hay ...	....	5,000 "	77 "	18 "	70 "
Oats	60 bu.	3,200 "	62 "	22 "	55 "
Onions	45,000 lbs.	....	72 "	37 "	71 "
Peas	30 bu.	3,000 lbs.	52 "	33 "	107 "
Potatoes......	200 "	1,500 "	74 "	21 "	46 "
Timothy......	....	4,000 "	94 "	23 "	88 "
Tobacco	1,600 lbs.	1,400 " stems	200 "	16 "	75 "
Tomatoes	10 tons	....	54 "	20 "	32 "
Turnips	700 bu.	5 tons	180 "	52 "	79 "

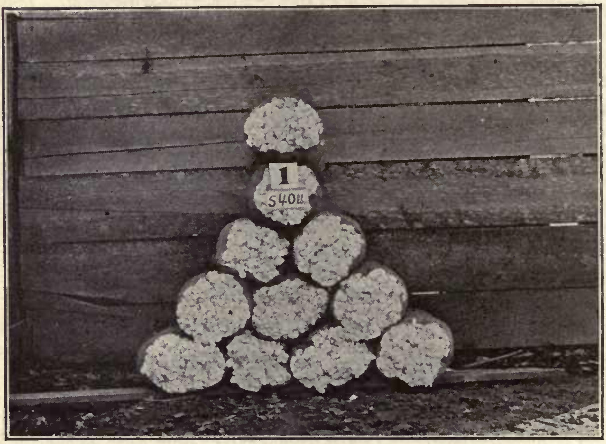
* Crimson clover.

APPENDIX

DESCRIPTION OF FERTILIZER MATERIALS

Broadly speaking, there are two kinds of fertilizers: those which are in themselves a direct source of plant food, and those which *by their action* tend to make plant-food fertilizers more available. While crops may be grown without the use of fertilizers of the second class, no crop can live without the fertilizers of the first class, even though ample applications be made of the former.

Fertilizers of the second class comprise lime, gypsum (plaster), and common salt, and are sometimes called "stimulant fertilizers." They tend to make rapidly available the stores of potash, phosphoric acid, and nitrogen naturally present in the soil. When stimulant fertilizers are used exclusively for a term of years, the soil each year loses potash, phosphoric acid, and nitrogen, which are not replaced. The inevitable result of such treatment must

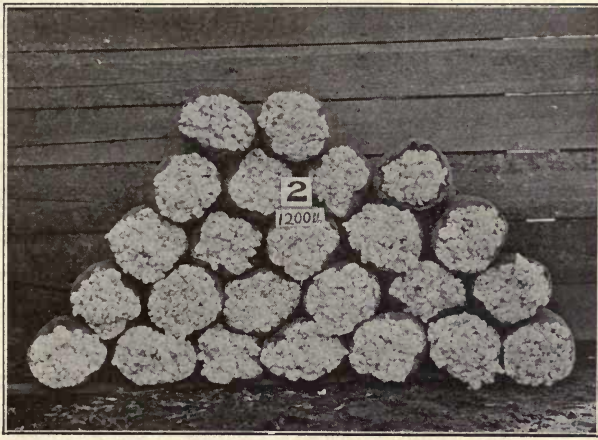


No Fertilizer. Yield, 540 lbs. Seed Cotton per acre.

RESULTS OF FERTILIZER TEST BY C. L. FREELING, BEEBE, ARK.

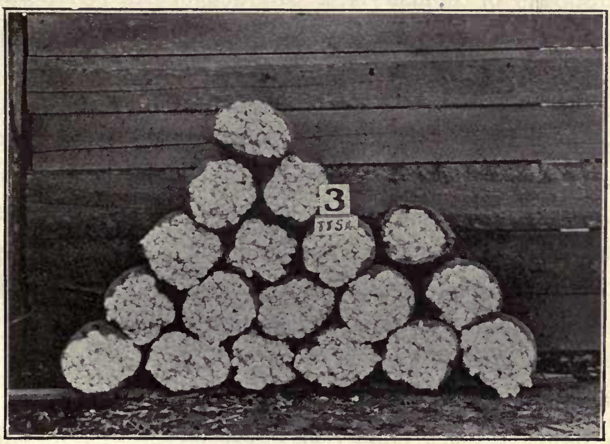
naturally be the exhaustion of these important food constituents from the soil.

True fertilizers contain forms of plant food, which contribute directly to the growth and substance of plants. Such materials may contain potash, or phosphoric acid compounds or nitrogenous substances; or any two, or all



Fertilized with Potash, Phosphate, and Nitrogen.

RESULTS OF FERTILIZER TEST BY C. L. FREELING, BEEBE, ARK.



Fertilized with Phosphate and Nitrogen. (No Potash.)
Yield, 885 lbs. Seed Cotton per acre.

RESULTS OF FERTILIZER TEST BY C. L. FREELING, BEEBE, ARK.

three of these forms of plant food. The tables given at the end of this chapter show the composition of the most commonly used fertilizers.

MATERIALS SUPPLYING POTASH

Kainit is the most common product of the German potash mines. It is a mixture of several different compounds, containing twelve to thirteen per cent of actual potash, together with about thirty-five per cent of common salt, also magnesia salts.

Muriate of Potash, also a product of the Stassfurt mines, is the main source of supply for potash for commercial fertilizers in our market, and contains from fifty to fifty-three per cent of actual potash.

Sulfate of Potash is a product of the German mines and as found in the market contains from forty-eight to fifty-one per cent of actual potash.

Sulfate of Potash Magnesia is known also as double manure salt, or low-grade sulfate of potash. This material contains twenty-six to twenty-eight per cent of actual potash and thirty-two to thirty-six per cent of sulfate of magnesia.

Wood Ashes contain a small amount of potash, which is present chiefly in the form of carbonate.

MATERIALS SUPPLYING PHOSPHORIC ACID

Bones consist chiefly of phosphate of lime, which constitutes from one-half to three-fifths of the weight of the bone. The remaining portion is a soft, flesh-like sub-

stance commonly called gelatine. It is distributed throughout the entire mass of bone, and is rich in nitrogen. When bones are burned, the nitrogenous matter is driven off and only the mineral portion of phosphate of lime remains. Bones, such as are used in making commercial fertilizers, contain four to five per cent of nitrogen and from twenty to twenty-five per cent of phosphoric acid. About two-thirds of the latter is insoluble and approximately one-third available.

Bone Products are valuable fertilizers, as they supply phosphoric acid, and generally nitrogen also. The most common forms are bone-black, bone meal, and bone tankage. Bone-black is a by-product of sugar refining, and contains from thirty to thirty-five per cent insoluble phosphoric acid. Dissolved bone-black contains sixteen to seventeen per cent available phosphoric acid. Bone meal is simply ground bones, steamed or raw. It contains two and one-half to five per cent of nitrogen and twenty to twenty-five per cent of phosphoric acid. Bone tankage is a very irregular product, but follows bone meal closely in composition. It is a by-product of the smaller packing houses.

Phosphate Rock is a mineral phosphate, found in various States. In a raw condition it contains from twenty-five to thirty-five per cent phosphoric acid, all of which is insoluble and not available for plant food. The mineral has to be treated with sulfuric acid, before the phosphoric acid can be liberated.

Acid Phosphates are known under several different names, such as superphosphates, dissolved bone, dissolved

rock, dissolved bone-black, etc. Acid phosphates are formed by treating some form of insoluble phosphate, as rock phosphate, bone, bone-ash, etc., with sulfuric acid. By this treatment there are formed soluble phosphates of lime and gypsum (sulfate of lime) in nearly equal proportions.

MATERIALS SUPPLYING NITROGEN

Nitrate of Soda, known as "Chili saltpeter," is found in large deposits which have been formed in the rainless regions of Chili and Peru.

Sulfate of Ammonia is formed from waste materials produced in the manufacture of gas or coke.

Whole Cotton Seed is rather slow in becoming available as a fertilizer. By rotting to "kill" the seed it is made more effective. The common practice is to pile in large heaps and leave standing for several months. This not only kills the seed, but also prevents the injurious action sometimes observed from using raw seed as manure. But a farmer cannot afford to use sound cotton seed as a fertilizer. The seed should be exchanged for cotton-seed meal.

Cotton-Seed Meal is the product formed by removing the oil from cotton seed by pressure, after which the material is dried and ground. The hulls of the cotton seed also possess some fertilizing value.

Tobacco Stems are the refuse from tobacco factories.

Dried Blood consists of blood obtained from slaughtering animals. It is prepared for market by coagulating,

drying and grinding. The color varies from red to black.

Dried Fish Scrap consists of the meat and bone of fish after the oil has been pressed out; it is dried artificially and ground for market.

Meat Scrap or Tankage, etc., is slaughter-house refuse, dried and ground.

Nitrogenous Guanos are formed in dry regions. The Peruvian guano is rich in nitrogen, containing seven per cent or more, and usually contains seven to twelve per cent phosphoric acid and about one per cent of potash.

There are several inferior sources of nitrogen, such as hair, hoof-meal, or horn-dust, leather scrap or meal, etc. While all these materials contain much nitrogen, they decay so slowly in the soil that they have a very uncertain fertilizer value.

TERMS USED IN STATING FERTILIZER ANALYSES

Fertilizer dealers and the Experiment Station Bulletins treat the different forms of fertilizer materials separately, and it is important that the farmer should be familiar with these trade names and understand what they mean.

The following list contains most of the terms used in stating fertilizer analyses:

Potash is expressed as: (*a*) Potash, (*b*) Potash (actual), (*c*) Potash S. (or Sul.), (*d*) Potash (soluble), (*e*) Potash as Sulfate, (*f*) Potash equal (or equivalent) to Sulfate of Potash, (*g*) Sulfate of Potash, (*h*) Potassium Oxide.

Phosphoric Acid is expressed as: (*a*) Phosphoric Acid, (*b*) Soluble Phosphoric Acid, (*c*) Reverted Phosphoric Acid, (*d*) Available Phosphoric Acid, (*e*) Soluble and Available Phosphoric Acid, (*f*) Insoluble Phosphoric Acid, (*g*) Total Phosphoric Acid, (*h*) Phosphoric Acid equal (or equivalent) to Bone Phosphate of Lime.

Nitrogen is expressed as: (*a*) Nitrogen, (*b*) Ammonia, (*c*) Nitrogen equal (or equivalent) to ammonia.

POTASH

(*a*) **Potash,** as used in connection with fertilizers, always means a compound containing potassium and oxygen, known chemically as potassium oxide. Potash is never found as such in fertilizers, but chemists, when expressing the results of analyses, use this form as a convenient standard for reference. Fertilizers generally contain potash in such forms as sulfate of potash, muriate of potash, or carbonate of potash. Instead of stating the amount of sulfate, muriate, or carbonate of potash present in a fertilizer, in giving the results of analyses, its equivalent amount is stated only in the form of actual potash.

(*b*) **Potash actual** is simply another name for potash, as distinct from sulfate, muriate, etc.

(*c*) **Potash S. (or Sul.),** means sulfate of potash. This is quite often used by manufacturers in giving guarantees.

(*d*) **Potash soluble** represents the amount of potash that dissolves in water and is available for the use of plants. The different forms of potash commonly used in fertilizers are readily soluble in water.

(*e*) **Potash as Sulfate** means simply sulfate of potash.

(*f*) **Potash Equal (or equivalent) to Sulfate of Potash** is an expression which means simply sulfate of potash.

(*g*) **Sulfate of Potash** signifies that this compound is actually present in the fertilizer, and that there is no muriate present.

(*h*) **Potassium Oxide** means the same as potash, or actual potash.

PHOSPHORIC ACID

(*a*) **Phosphoric Acid,** as used in connection with fertilizers, is a compound containing phosphorus and oxygen, which in fertilizers is never found by itself, but in combination with lime. Phosphoric acid stands for a certain amount ot phosphate of lime. We may say roughly that one part of phosphoric acid is equivalent to about two parts of phosphate of lime.

(*b*) **Soluble Phosphoric Acid** represents the amount of phosphate of lime that dissolves easily in water. It is formed by treating with sulfuric acid some form of insoluble lime phosphate, such as bones, phosphate rock, etc. The phosphate thus formed is readily soluble in water.

(*c*) **Reverted Phosphoric Acid** is formed from soluble phosphoric acid under certain conditions into which we need not inquire here. Suffice it to say that the soluble compound of phosphoric acid often changes to some extent, on standing, into a form which, while less soluble, is still quite readily available as plant food.

(*d*) **Available Phosphoric Acid** includes both the solu-

ble and reverted forms of phosphoric acid, because both forms are available for the use of plants.

(*e*) **Soluble and Available Phosphoric Acid** is an expression which means the same as available.

(*f*) **Insoluble Phosphoric Acid** represents the form of phosphoric acid in raw phosphate of lime, and which is of least value for agricultural purposes.

(*g*) **Total Phosphoric Acid** represents all of the phosphoric acid compounds without regard to the forms in which they exist. The total phosphoric acid is, therefore, the sum of the soluble, reverted, and insoluble forms; or, to state it in another way, the sum of the available and insoluble forms.

(*h*) **Phosphoric Acid equal (or equivalent) to Bone Phosphate of Lime** is an expression which usually means nothing more or less than insoluble phosphoric acid.

NITROGEN (AMMONIA)

(*a*) **Nitrogen** is a gas and, in this form, cannot be used in fertilizers. Therefore, whenever we speak of nitrogen in fertilizers we do not mean that nitrogen exists in them as simple nitrogen. The nitrogen in fertilizers is always combined with other elements, and may be present in one or more different forms: (1st) in the form of nitrates, as nitrate of soda; (2d) in the form of ammonia compounds, as sulfate of ammonia; and (3d) in the form of organic matter, animal or vegetable, as dried blood, meat, tobacco stems, etc. Chemical analysis according to official methods

does not attempt to ascertain and state in which form or forms the nitrogen is present in a fertilizer.

When, therefore, nitrogen is expressed in an analysis or guarantee as "ammonia," it refers to the entire amount of nitrogen, without regard to the particular form or forms in which it is present.

(*b*) **Ammonia** consists of nitrogen combined with hydrogen. A pound of nitrogen will form more than a pound of ammonia, because the ammonia formed from a pound of nitrogen will contain that pound of nitrogen plus the necessary amount of hydrogen added to form ammonia. The chemical relations of nitrogen and ammonia are such that fourteen pounds of nitrogen will unite with exactly three pounds of hydrogen, and will, therefore, produce seventeen pounds of ammonia; or one pound of nitrogen will make 1.214 pounds of ammonia.

(*c*) **Nitrogen equal (or equivalent) to Ammonia** is a form of expression which simply means that the nitrogen is stated not as nitrogen but as ammonia.

It would be better on every account if all guarantees stated simply nitrogen and never mentioned ammonia at all. As a matter of fact, compounds of ammonia are quite uncommon in commercial fertilizers, because nitrogen in this form is the most expensive and, therefore, least used. Strictly speaking, the term ammonia should never be used except when sulfate of ammonia or some similar compound is present in the fertilizer.

The following table gives the composition of the most commonly known fertilizer materials:

Composition of Fertilizer Materials Used as Sources of Phosphoric Acid

	Nitrogen Per cent	Equivalent in Ammonia Per cent	Potash (K_2O) Per cent	Phosphoric Acid Total Per cent	Phosphoric Acid Available Per cent	Phosphoric Acid Insoluble Per cent
South Carolina phosphate rock	....	....	......	26 to 27	......	26 to 27
South Carolina acid phosphate	....	....	......	13 to 16	12 to 15	1 to 3
Florida land rock	....	....	......	33 to 35	......	33 to 35
Florida pebble phosphate	....	....	......	26 to 32	......	26 to 32
Florida acid phosphate	....	....	......	14 to 19	13 to 16	1 to 3
Tennessee phosphate	....	....	......	34 to 39	......	34 to 39
Tennessee acid phosphate	....	....	......	14 to 19	13 to 16	1 to 3
Bone-black (spent)	....	....	......	32 to 35	......	32 to 35
Bone-black (dissolved)	....	....	......	17 to 19	16 to 17	1 to 2
Bone meal	2.5 to 4.5	3 to 5.5	......	20 to 25	5 to 8	15 to 17
Bone (dissolved)	2 to 3	2.5 to 3.5	......	15 to 17	13 to 15	2 to 3

Composition of Fertilizer Materials Used as Sources of Nitrogen

	Nitrogen Per cent	Equivalent in Ammonia Per cent	Potash (K_2O) Per cent	Phosphoric Acid Total Per cent
Nitrate of soda	15 to 16	18 to 19.5	......	....
Sulphate of ammonia	19 to 22	23 to 26	......	....
Dried blood (high grade)	12 to 14.5	14.5 to 17.5	......	....
Dried blood (low grade)	10 to 11	12 to 14.5	......	3 to 5
Concentrated tankage	11 to 12.5	13.5 to 15	......	1 to 2
Tankage	5 to 6	6 to 7.5	......	11 to 14
Tankage	7.5 to 9	9 to 11	......	8.5 to 10.5
Dried fish scrap	9.5 to 11	11.5 to 13.5	......	6 to 8
Cotton-seed meal	6.5 to 7.5	8 to 9	1.5	2
Cotton seed	3 to 4	3.5 to 4.5	1	1.5
Castor pomace	5 to 6	6 to 7.5	1	2
Tobacco stems	2 to 3	2.5 to 4	5 to 8	About 1%

Composition of Fertilizer Materials Used as Sources of Potash

	Pure Potash (K_2O) Per cent	Lime Per cent	Nitrogen Per cent	Equivalent in Ammonia Per cent	Phosphoric Acid, Total Per cent	Chlorine Per cent
Muriate of potash	48 to 54	....	......	....	......	45 to 48
Sulfate of potash (high grade)	48 to 52	....	......	....	......	0.3 to 1.5
Sulfate of potash, magnesia	27 to 30	0.85	......	....	......	1.5 to 2.5
Kainit	12.5	1.12	......	....	......	30 to 32
Manure salt	20	....	......	....	......	40 to 45
Wood ashes (unleached) ...	2 to 8	30 to 35	......	....	1 to 2	....
Wood ashes (leached).....	1 to 2	35 to 40	......	....	1 to 1.5	....
Tobacco stems	5 to 8	3.5	2 to 3	2.5 to 3.5	......	....